



Biological Assessment Report

Long Branch Pettis and Johnson Counties, Missouri

Fall 2016 – Spring 2017

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MoDNR**) Water Protection Program (**WPP**), the Environmental Services Program (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate biological assessment and habitat study of Long Branch (water body identification [**WBID**] numbers 1843 and 0857), during the fall of 2016 and spring of 2017. As part of a stressor analysis study, multiparameter sondes were deployed at two stations in August 2016 to record dissolved oxygen (**DO**) concentrations. Fall sampling was conducted on September 15, 2016, and consisted of macroinvertebrate sampling, stream habitat assessments, and water quality sampling at four stations on Long Branch. During the spring, sampling was conducted on March 22, 2017, and consisted of macroinvertebrate sampling and water quality sampling at the same study stations. Sampling was conducted by Brandy Bergthold, Raissa Espejo, Brian Nodine, and Dave Michaelson.

Long Branch is classified as a class P stream in the Missouri Water Quality Standards (**WQS**) from its confluence with Muddy Creek upstream to Section 6, T. 45 N., R. 23 W. (WBID 1843) and class C from Section 6 to the upstream boundary located at Section 9, T. 45 N., R. 24 W. (WBID 0857) (MoDNR 2014b). Long Branch has the following designated uses: irrigation, livestock and wildlife watering; protection of warm water habitat and human health protection; category B whole body contact recreation; and secondary contact recreation (MoDNR 2014b). A class P stream is defined as a stream that maintains permanent flow even in drought periods. Class C streams may cease flow during dry periods but maintain permanent pools. Category B whole body contact applies to waters that are not designated for public swimming areas and public recreational uses.

Long Branch was added to the 2002 MoDNR 303(d) List of Impaired Waters for low biodiversity due to unknown pollutants and sources, significant amounts of filamentous algae, and elevated specific conductance measurements indicating an impairment of aquatic life. A bioassessment of Long Branch conducted in fall 2007 and spring 2008 reaffirmed that the stream's aquatic life remained impaired (MoDNR 2008). The U.S. Environmental Protection Agency (**U. S. EPA**) conducted additional water quality testing in 2009 and 2010 that indicated elevated nutrients and excessive sediment were an issue. U. S. EPA approved a final Total Maximum Daily Load (**TMDL**) study on December 20, 2010, for total suspended solids (**TSS**), total nitrogen, and total phosphorus for Long Branch in Johnson and Pettis counties (U. S. EPA 2010). Missouri does not currently have nutrient criteria for streams and rivers nor criteria established for TSS in surface waters. The TMDL nutrient targets were based on the U. S. EPA's recommended criteria for Ecoregion 40, the Central Irregular Plains (U. S. EPA 2000). The TSS target was based on the 25th percentile of the TSS data collected within the same geographic region as Long Branch (U. S. EPA 2000, 2010).

A fish kill was reported in Long Branch and Muddy Creek in Johnson and Pettis counties in April 2015 (MDC 2015). Toxic levels of ammonia caused a complete kill of fish, tadpoles, and benthic macroinvertebrates (including mussels and snails). The suspected

source of toxic ammonia was a release of chicken wastewater and manure from Johnson County Egg Farm, LLC (MDC 2015). A similar fish kill occurred in 1989 at the same location.

2.0 Study Area and Sampling Locations

Long Branch originates in western Johnson County and flows east into Pettis County. Long Branch is located within the Central Plains/Blackwater/Lamine Ecological Drainage Unit (EDU) (Figure 1). An EDU is a region in which biological communities and habitat conditions can be expected to be similar.

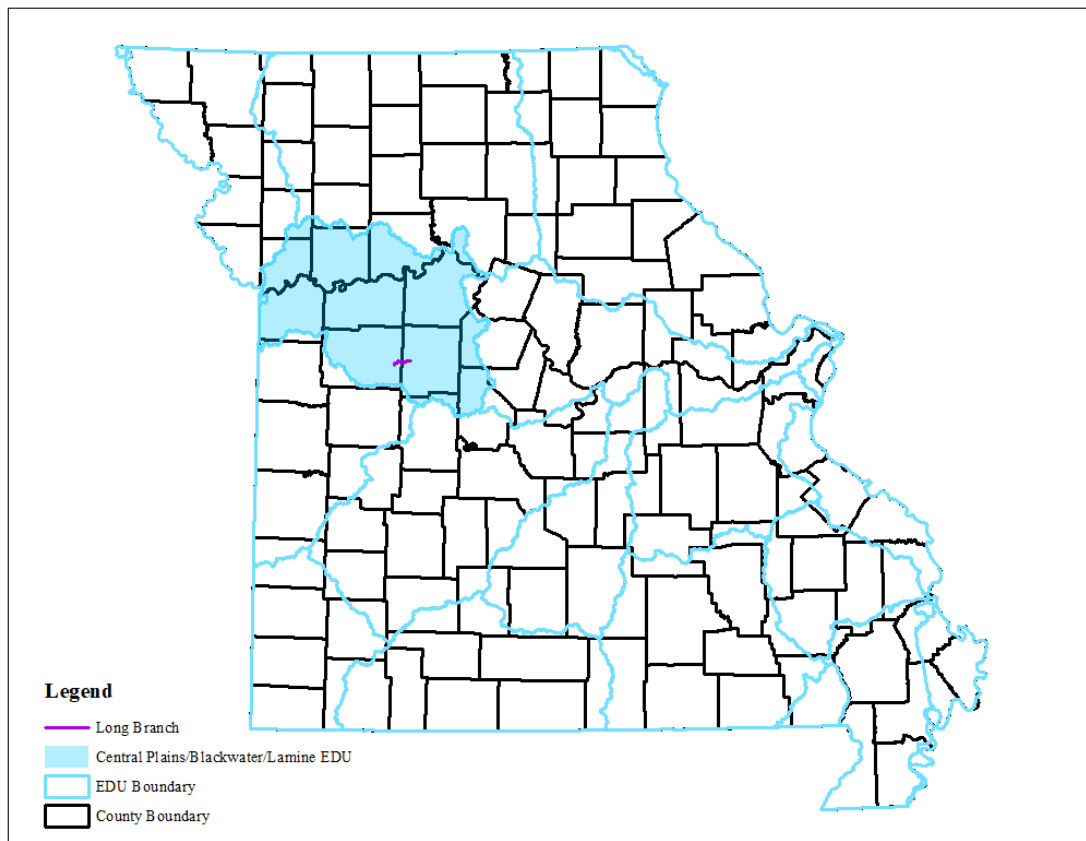


Figure 1. Location of Long Branch within the Central Plains/Blackwater/Lamine EDU

Four stations were chosen for this study. The lower two stations, 0.1 and 0.5, were located within the class P designated section of the stream. Stations 1.0 and 1.9 were located within the class C section. Station locations and descriptions are listed below and shown in Figure 2. Stations 0.1, 0.5, and 1.0 are located downstream of the Johnson County Egg Farm, LLC. All four stations are located downstream of the Whiteman Air Force Base.

Sampling Locations

All Long Branch stations were located in Universal Transverse Mercator (**UTM**) Zone 15.

Long Branch Station 0.1 (SW1/4, NW1/4, sec. 34, T. 46 N., R. 23 W.) is located upstream of Mahin Road in Pettis County. UTM coordinates recorded at the upstream boundary of the sample reach are UTMN 4286776, UTME 460837.

Long Branch Station 0.5 (SW1/4, NW1/4, sec. 05, T. 45 N., R. 23 W.) is located downstream of Long Branch Road, an abandoned County Road in Pettis County. UTM coordinates recorded at the upstream terminus of the sample reach are UTMN 4285536, UTME 457757.

Long Branch Station 1.0 (E1/2, sec. 1, T. 45 N., R. 24 W.) is located downstream of the Thompson Road bridge in Pettis County. Thompson Road lies along the north and south boundary between Pettis and Johnson counties. UTM coordinates recorded at the upstream terminus are UTMN 4285522, UTME 456171.

Long Branch Station 1.9 (NW1/4, NE1/4, sec. 02, T. 45 N., R. 24 W.) is located downstream of State Highway D in Johnson County. The UTM coordinates recorded at the upstream terminus are UTMN 4286110, UTME 453788.

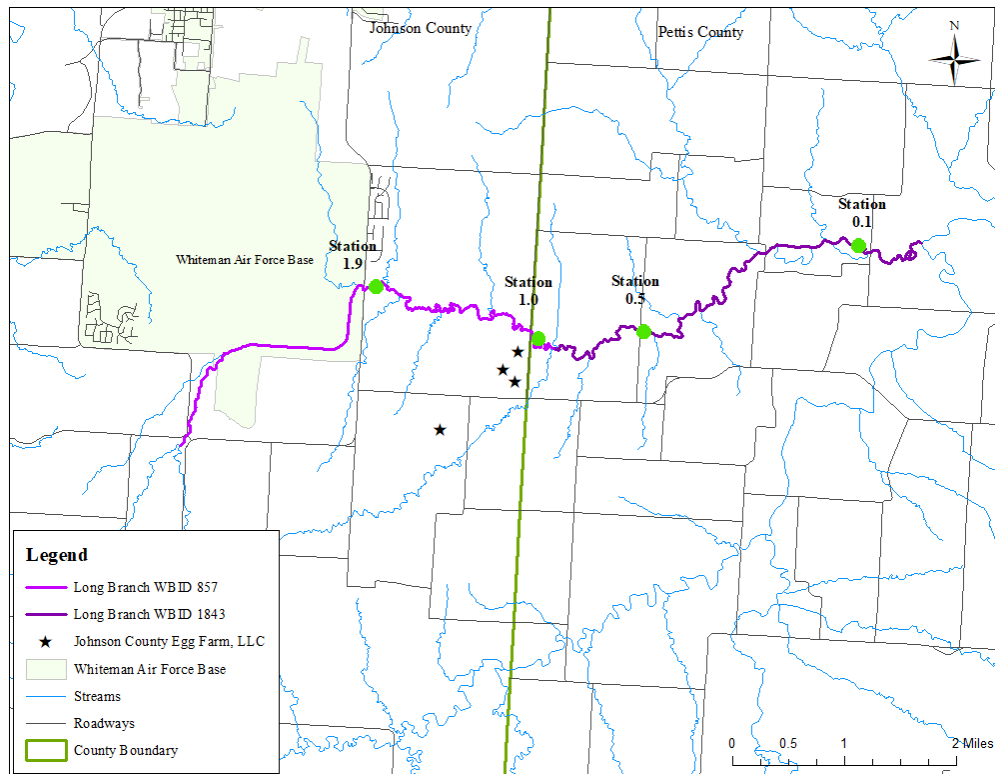


Figure 2. Long Branch Sampling Locations

3.0 Objectives

The objective of this study was to determine if Long Branch supports its protection of warm water habitat beneficial use designation by using biological criteria calculated from reference stream macroinvertebrate data in the Central Plains/Blackwater/Lamine The macroinvertebrate community and instream habitat were compared longitudinally among four Long Branch stations and compared with biological criteria reference (**BIOREF**) stream data from the Central Plains/Blackwater/Lamine EDU. Water quality was compared longitudinally among the Long Branch study sites and also compared with Missouri's WQS (MoDNR 2014b) and U. S. EPA's TMDL targeted values for total nitrogen, total phosphorus, and TSS (U. S. EPA 2010).

3.1 Null Hypotheses

- 1) Land cover characteristics in the Long Branch watershed will be similar to land cover characteristics of the Central Plains/Blackwater/Lamine EDU.
- 2) Stream habitat assessment scores of Long Branch will be similar to those of East Fork Crooked River, a BIORREF stream in the Central Plains/Blackwater/Lamine EDU.
- 3) The Long Branch macroinvertebrate community will be similar among longitudinally separate sample reaches.

4) The macroinvertebrate community in Long Branch will be similar to the macroinvertebrate community of BIOREF streams in the Central Plains/Blackwater/Lamine EDU.

5) Physicochemical water quality of Long Branch will meet the WQS and target levels established by the U. S. EPA's TMDL.

4.0 Methods

4.1 Land Use Description

Percent land use data were derived from Thematic Mapper satellite images from 2000-2004 and interpreted by the Missouri Resource Assessment Partnership (Sowa et al. 2004). Land cover percentages from the Central Plains/Blackwater/Lamine EDU and the 12-digit Hydrologic Unit Code (HUC) containing the study stations are presented in tabular and graphic format in the Results section.

4.2 Stream Habitat Assessment Project Procedure

Standardized assessment procedures were followed as described for glide/pool prevalent streams in the Stream Habitat Assessment Project Procedure (SHAPP, MoDNR 2016j). According to the SHAPP, an aquatic community is influenced by the quality of the stream habitat. Stream habitat quality is scored for each station, and the scores are compared with a control stream SHAPP score (in this case, a BIOREF stream reach). If the SHAPP score at a study station is ≥ 75 percent of the SHAPP control score, the stream habitat at the study station is considered to be comparable to the control stream. East Fork Crooked River, located northeast of Richmond in Ray County, Missouri, is a BIOREF stream that was chosen as the SHAPP control. The habitat assessment of East Fork Crooked River was conducted on September 27, 2016. SHAPP scores were calculated for the Long Branch stations, compared to East Fork Crooked River, and examined for irregular results.

4.3 Macroinvertebrate Sampling and Analyses

Macroinvertebrate sampling was conducted according to the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP, MoDNR 2012). Long Branch is considered a glide/pool dominated system. The three standard habitats sampled at all locations were non-flowing water over depositional substrate, large woody debris substrate, and submerged rootmat. Macroinvertebrate samples were subsampled in the laboratory and identified to specific taxonomic levels (MoDNR 2016g) in order to develop biological metric values (MoDNR 2012).

BIOREF streams within the EDU represent the best available conditions and are the basis for calculating Macroinvertebrate Stream Condition Index (MSCI) scores. Long Branch macroinvertebrate data were evaluated relative to BIOREF streams in the Central Plains/Blackwater/Lamine EDU. Biological criteria are calculated separately for the fall (mid-September through mid-October) and spring (mid-March through mid-April) index

periods. The SMSBPP provides details on the calculation of metrics and scoring of the multi-metric MSCI. The four components of the MSCI are Taxa Richness (**TR**); Ephemeroptera, Plecoptera, and Trichoptera Taxa (**EPTT**); Biotic Index (**BI**); and the Shannon Diversity Index (**SDI**). An MSCI score of 16-20 is considered fully supporting, 10-14 partially supporting, and 4-8 non-supporting of the protection of warm water habitat beneficial use designation as listed in the WQS (MoDNR 2014b).

4.4 Multiparameter Data Sonde Collection

Two YSI Model 600 OMS V2 data loggers (YSI Incorporated, Yellow Springs, Ohio 45387 [a subsidiary of Xylem Incorporated]) were deployed for two-weeks during anticipated summertime low-flow periods to measure DO, temperature, and specific conductivity every 15 minutes. Data logger use was conducted following Standard Operating Procedure (**SOP**) MDNR-ESP-104, *Continuous Monitoring of Water Quality Using a Dissolved Oxygen, Specific Conductivity, pH, Turbidity, Rhodamine Dye, and Temperature Data Logger* (MoDNR 2014a).

4.5 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MoDNR ESP Standard Operating Procedure or Project Procedure. Results for physicochemical water parameters were examined by season and station for *in situ* field measurements or grab samples collected in accordance with the SOP MDNR-ESP-001, *Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2016a). All samples were kept on ice during transport to ESP.

Water quality parameters were measured *in situ* or collected and returned for analyses at the ESP laboratory in Jefferson City. Turbidity (**NTU**, MoDNR 2016b) was measured in the ESP, WQMS biology laboratory. Discharge (cubic feet per second-cfs, MoDNR 2015), DO (mg/L, MoDNR 2016f), specific conductance ($\mu\text{S}/\text{cm}$, MoDNR 2016e), pH (MoDNR 2016c), and temperature ($^{\circ}\text{C}$, MoDNR 2016d), were measured in the field. The ESP Chemical Analysis Section conducted analyses for the following: nitrate+nitrite-nitrogen, total nitrogen, total phosphorus, ammonia as N, sulfate, chloride, and TSS/non-filterable residue (all parameters reported in mg/L).

4.6 Discharge

Stream discharge was measured using a SonTek/YSI FlowTracker Handheld Acoustic Doppler Velocimeter at all stations during both sampling seasons in accordance with the SOP MDNR-ESP-113, *Flow Measurements in Open Channels* (MoDNR 2015).

4.7 Quality Assurance/Quality Control (QA/QC)

4.7.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with *Quality Control Procedures for Checking Water Quality Field Instruments* (MoDNR 2016h).

4.7.2 Biological Samples

Steps consistent with those methods found in the SMSBPP document (MoDNR 2012) were performed to ensure accuracy of organism removal from sample debris.

4.7.3 Biological Data Entry

All macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with *Quality Control Procedures for Data Processing* (MoDNR 2016i).

4.7.4 Duplicate Sample Collection

Duplicate samples are collected at two randomly selected sampling stations per season for macroinvertebrates and for 10 percent of water samples. Duplicate samples are obtained from the same location at essentially the same time as the true sample following procedures described in *Quality Assurance/Quality Control for Environmental Data Collection* (MoDNR 2013). True samples and duplicate samples are analyzed for the same set of parameters. A duplicate is used to assess the precision associated with sampling methodology, sample heterogeneity, and analytical procedures (MoDNR 2013). No duplicate sample collections, macroinvertebrate or water chemistry, were chosen for this study.

5.0 Results

5.1 Land Use

Land use data in Table 1 provide a comparison between the Long Branch study reach 12-digit HUC and the Central Plains/Blackwater/Lamine EDU. All Long Branch stations are located within the same 12-digit HUC. A graphic representation of land use in the watershed is shown in Figure 3.

Table 1
Percent Land Use in Long Branch Sampling Stations
And the Central Plains/Blackwater/Lamine EDU

	12-digit HUC	Urban/Im- pervious	Crop- land	Grass- land	Forest- land	Herba- ceous	Wetland/ Open water
Long Branch	103001030402	6.3	42.3	42	6.2	1.1	2.0
Central Plains/ Blackwater/Lamine EDU	--	8.0	38.2	31.5	15.9	2.1	4.4

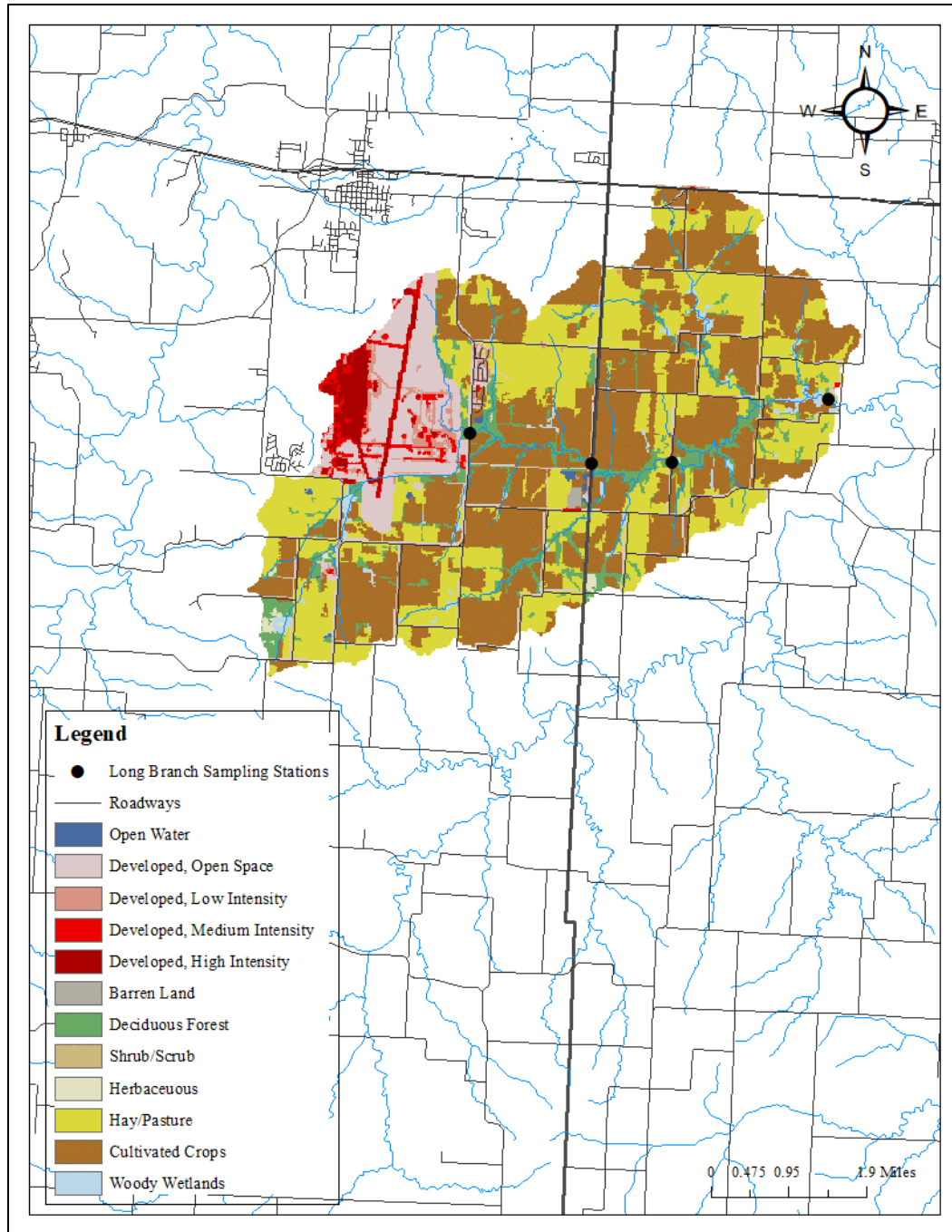


Figure 3. Land Uses within the Long Branch Watershed

Comparison of land use between the 12-digit HUC containing the study segments and the Central Plains/Blackwater/Lamine EDU showed the study stream contained more grassland and cropland than the EDU. The Long Branch watershed contained less urban/impervious cover and less than half the amount of forestland and wetland/open water than the EDU.

5.2 Stream Habitat Assessment

Habitat assessment scoring results are found in Table 2. If the study station SHAPP score is ≥ 75 percent of the control station score, the station is considered to contain comparable habitat to the control station. All stations scored ≥ 75 of the SHAPP control, East Fork Crooked River. Based on SHAPP scores, it is inferred that the Long Branch stations have habitats similar to the BIOREF stream and should, therefore, support a comparable biological community.

Table 2
Habitat Values and Scores from Stream Habitat Assessments
for Long Branch and the East Fork Crooked River

Stream Habitat Parameters	Long Br. 0.1	Long Br. 0.5	Long Br. 1.0	Long Br. 1.9	East Fork Crooked R.
Habitat Assessment Date	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/27/2016
Epifaunal Substrate/Avail. Cover	I (16)	IV (4)	III (7)	IV (3)	II (11)
Pool Substrate Characterization	I (17)	II (14)	III (7)	III (6)	II (12)
Pool Variability	III (10)	III (6)	III (8)	III (6)	II (14)
Sediment Deposition	I (16)	III (7)	III (9)	III (10)	II (13)
Channel Flow Status	I (17)	I (17)	II (15)	II (12)	II (14)
Channel Alteration	I (20)	I (19)	I (20)	I (19)	I (20)
Channel Sinuosity	III (8)	III (6)	III (7)	III (6)	III (6)
Left Bank Stability	II (7)	I (9)	II (7)	II (8)	II (7)
Right Bank Stability	I (9)	I (9)	II (6)	II (8)	III (5)
Left Bank Vegetative Protection	IV (1)	III (4)	IV (2)	IV (2)	IV (1)
Right Bank Vegetative Protection	IV (2)	IV (2)	IV (2)	IV (1)	IV (1)
Left Bank Riparian Zone Width	I (9)	II (7)	I (9)	I (10)	III (4)
Right Bank Riparian Zone Width	I (10)	I (10)	II (7)	I (10)	I (9)
Total habitat Score	142	114	106	101	117
Percentage of BIOREF	>100	97	91	86	---

Habitat parameter categories range from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor. Habitat parameter scores are listed in parentheses and range from 0 to 20 except for vegetative protection and riparian zone categories, which range from 0 to 10.

Long Branch ranked poor in epifaunal substrate at stations 0.5, 1.0, and 1.9. The substrate was mostly mud or hard packed clay with steep banks. Little gravel and no cobble was present instream, and minimal rootmat was present. Woody debris was scarce. Station 0.1 had gravel present and more woody debris than the other stations, ranking it higher in epifaunal substrate. Few shallow pools were present throughout the stream, and sediment deposition along bends and obstructions were lowest at the farthest downstream station. Channel flow status was optimal at stations 0.1 and 0.5, with water filling approximately 80 percent of the channel but ranked lower at stations 1.0 and 1.9. Although channel alterations were minimal through the study reach, channel sinuosity was low at all study stations, only increasing the stream length by 1.5 times at most. Little active erosion was visible, and stream banks were considered moderately stable among all stations. Although vegetative protection along the banks was low, the stations mostly had well-established riparian corridors along both banks with a good mix of trees, understory growth, and grasses.

Station 1.0 had an illegal trash dumping site along the banks and in the stream itself. Trash and tires were present at the station during reconnaissance and the fall sampling. Some of the trash had sediment built up around it, indicating that dumping was not a recent occurrence. During the spring sampling event, a large amount of solid waste (bags and boxes of household material, trash, and furniture) had recently been dumped from the bridge into the stream.

East Fork Crooked River, the SHAPP control, ranked suboptimal on epifaunal substrate. The substrate consisted mostly of soft sand, mud, and clay but also had pockets of gravel and more instream woody debris and rootmat than the study stream. There was some sediment deposition evident and few shallow pools. Channel flow status ranked comparable to the two upstream study stations. There were no evident channel alterations and no tires or trash found instream. Although sinuosity was low, it was comparable to Long Branch, with the length only increasing a minimal amount (1.1 times longer than if the stream was a straight line). The stream banks had areas of active erosion, and vegetative protection along the banks was minimal. The riparian area along East Fork Crooked River was marginal along the left bank due to crop fields and pastureland.

5.3 Biological Assessment and Macroinvertebrate Community Analyses

Tables 3 and 4 provide scoring criteria and results for the fall and spring index periods, respectively. MSCI scores were calculated by scoring study station biological metrics using the appropriate BIOREF criteria. An MSCI score of 16-20 is considered fully supporting, 10-14 is partially supporting, and 4-8 is considered non-supporting. Long Branch had fully supporting MSCI scores at two of the four stations during the fall and one station during the spring. The farthest downstream station was the only station to attain fully supporting MSCI scores during both sampling seasons.

Table 3
Metric Values and Scores for Long Branch Stations, Fall 2016,
Using Central Plains/Blackwater/Lamine Biological Criteria

Stations	TR	EPTT	BI	SDI	MSCI	Support
Long Branch 0.1	61	7	7.4	3.29		
Score	5	5	5	5	20	Full
Long Branch 0.5	55	3	7.4	2.60		
Score	3	3	5	3	14	Partial
Long Branch 1.0	59	4	7.3	2.68		
Score	5	3	5	3	16	Full
Long Branch 1.9	57	2	7.7	2.93		
Score	5	1	3	5	14	Partial
BIOREF Score=5	>55	>6	<7.6	>2.85	20-16	Full
BIOREF Score=3	55-27	6-3	7.6-8.8	2.85-1.43	14-10	Partial
BIOREF Score=1	<27	<3	>8.8	<1.43	8-4	Non

MSCI Scoring Table (in light gray) developed from BIORREF streams ($n = 14$). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index.

Table 4
Metric Values and Scores for Long Branch Stations, Spring 2017,
Using Central Plains/Blackwater/Lamine Biological Criteria

Stations	TR	EPTT	BI	SDI	MSCI	Support
Long Branch 0.1	58	5	8.0	2.7		
Score	5	3	3	5	16	Full
Long Branch 0.5	49	2	7.6	2.84		
Score	3	1	3	5	12	Partial
Long Branch 1.0	43	0	8.3	1.6		
Score	3	1	3	3	10	Partial
Long Branch 1.9	55	3	7.3	3.08		
Score	5	1	3	5	14	Partial
BIOREF Score=5	>50	>8	<7.3	>2.53	20-16	Full
BIOREF Score=3	50-25	8-4	7.3-8.7	2.53-1.27	14-10	Partial
BIOREF Score=1	<25	<4	>8.7	<1.27	8-4	Non

MSCI Scoring Table (in light gray) developed from BIORREF streams ($n = 12$). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index.

The fall 2016 macroinvertebrate community analysis is shown in Table 5. EPT taxa made up from 2.2 percent to 13.9 percent of samples (compared to the BIORREF average of 21.8 percent). Ephemeroptera were present at each station. Trichoptera were present at stations 0.5 and 1.0 but absent from the upstream and downstream stations. Although Plecoptera

taxa were absent from all Long Branch stations, they were also absent from Central Plains/Blackwater/Lamine BIOREF fall samples used to calculate criteria. Dipteran taxa ranged from 31 percent to 78.7 percent, with Chironomidae being the most abundant family at all four stations. The Chironomidae taxa *Tanytarsus* and *Dicrotendipes* were commonly collected at all four stations. The heptageniid mayflies *Stenonema femoratum* and *Stenacron* were most common at the downstream station. The snail *Menetus* (Planorbidae) was present at all stations but was much more abundant at station 0.5 than the other three stations. *Physella* (Physidae), a tolerant bladder snail, was present at all stations, occurring in higher abundance at station 1.9. *Caenis latipennis* (Caenidae), *Dubiraphia* (Elmidae), and *Berosus* (Hydrophilidae) were common taxa also collected at station 1.9.

Table 5
Fall 2016 Macroinvertebrate Community Analysis

Stations	BIOREF Average	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Variables					
% Ephemeroptera	20.1	11.9	1.7	3.6	13.9
% Plecoptera	0.0	0	0	0	0
% Trichoptera	1.7	0	0.5	0.4	0
% Total EPT	21.8	11.9	2.2	4.0	13.9
% Diptera	41.8	51.9	66.7	78.7	31
% Dominant Macroinvertebrate Families					
Chironomidae	37.6	51.3	66.4	78.1	30.4
Heptageniidae	8.8	9.6	1.3	3.2	0.4
Physidae	2.2	6.4	7.3	2.0	16.4
Ancylidae	0.5	6	2.1	3.4	0.4
Coenagrionidae	3.0	5.3	1.2	1.5	2.0
Elmidae	4.7	5.0	1.2	0.2	12.1
Planorbidae	0.7	2.8	13.8	0.7	0.8
Tubificidae	8.4	2.5	1.9	5.9	4.2
Hydrophilidae	--	1.2	0.4	--	7.2
Caenidae	6.2	0.6	--	0.4	13.5
Hyalellidae	3.8	0.6	--	<0.1	6

In Long Branch, taxa with BI values ≥ 5.0 (more tolerant) made up approximately 99 percent of the samples (Figure 4). In comparison, BIOREF streams had 93 percent of taxa within the same category. Taxa with BI values < 5.0 (more sensitive) ranged from 0.2 percent to 1.6 percent of Long Branch samples, compared to BIOREF streams in which the lower BI category composed an average of 6.8 percent of samples.

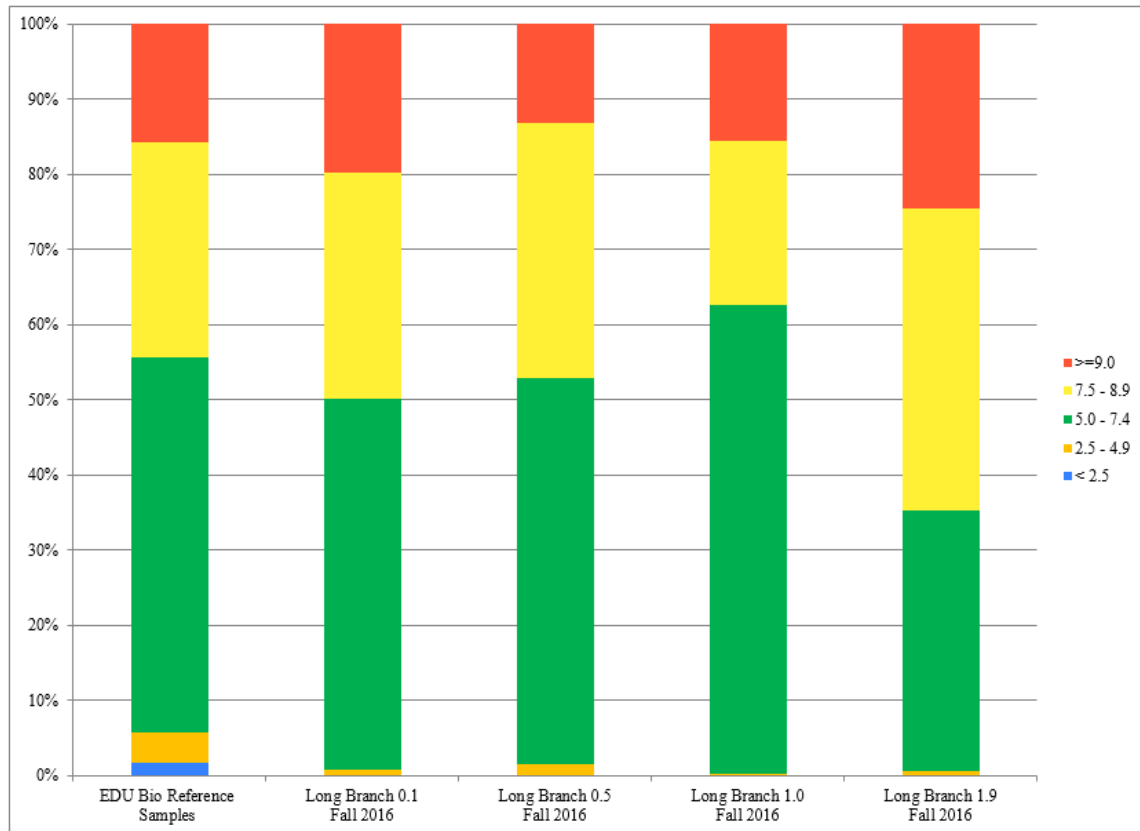


Figure 4. Fall 2016 Percent Taxa by Biotic Index Range

The spring 2017 macroinvertebrate community analysis is shown in Table 6. The total percentage of EPT taxa ranged from 0 to 18 percent among the study stations and made up 10.3 percent of the biological community among BIOREF samples. EPT taxa were completely absent from station 1.0, and Plecoptera were absent from all stations. Ephemeroptera and Trichoptera were less abundant during the spring sampling season than the fall. As in the fall, the two mid-stations had fewer Ephemeroptera and Trichoptera than the upstream or downstream stations. Dipteran taxa were present in higher numbers, making up from 54.8 percent to 94.4 percent of samples. As in the fall, Chironomidae was the dominant family with *Hydrobaenus* and *Cricotopus/Orthocladius* common at all stations. *Menetus* (Planorbidae) and *C. latipennis* (Caenidae) were common at the most downstream station, and an undescribed dipteran taxon was prevalent at station 0.5.

Table 6
Spring 2017 Macroinvertebrate Community Analysis

Stations	BIOREF Average	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Variables					
% Ephemeroptera	7.9	1.3	0.7	0	17.9
% Plecoptera	1.3	0	0	0	0
% Trichoptera	1.1	0.3	0.1	0	<0.1
% Total EPT	10.3	1.6	0.8	0	18
% Diptera	62.3	78	78.5	94.4	57
% Dominant Macroinvertebrate Families					
Chironomidae	54.4	76.4	68.3	94.1	54.8
Planorbidae	--	7.3	6.3	0.2	1.3
Elmidae	0.4	2.5	0.3	--	5.3
Ancylidae	--	1.8	0.5	0.6	--
Coenagrionidae	0.2	1.8	0.1	0.1	3.7
Insecta (undescribed Diptera)	0.4	1.4	9.6	--	0.6
Caenidae	3.2	0.6	--	--	17.4
Tubificidae	10.3	0.6	5.7	2.2	1.3
Hyaellidae	2.3	--	--	--	4.7

The percentage of taxa with BI values ≥ 5.0 was slightly higher in Long Branch than in the BIORF streams (Figure 5). The Long Branch stations had approximately 94 to 98 percent of taxa with BI values ≥ 5.0 whereas the BIORF streams had approximately 92 percent of taxa in the same category. Taxa within the lower category of <5.0 BI values ranged from 2.2 to 6.3 percent in the Long Branch stations compared to 10.3 percent of the BIORF streams in the more sensitive category.

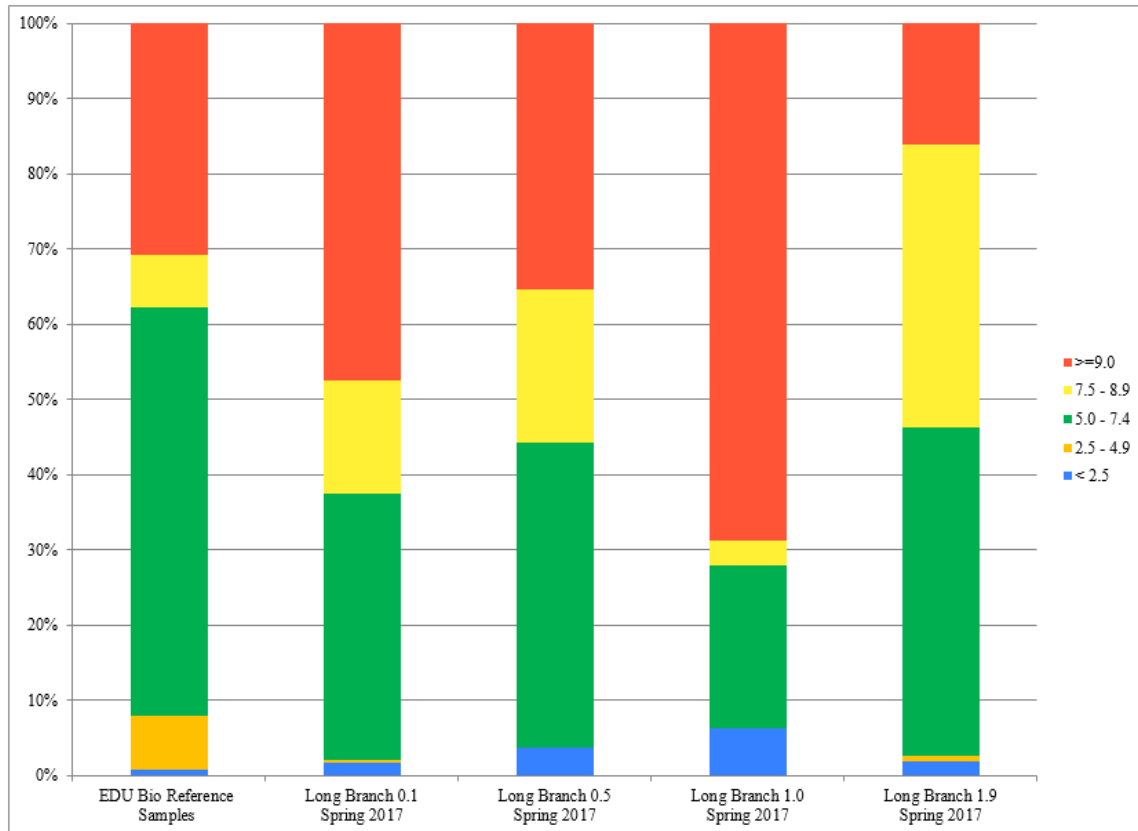


Figure 5. Spring 2017 Percent Taxa by Biotic Index Range

5.4 Sonde Deployment: Dissolved Oxygen, Temperature, and Specific Conductivity

Data loggers were deployed at two stations on Long Branch (stations 0.1 and 0.5) for two weeks in August 2016. Both stations are located within WBID 1843, the section classified as perennial. Data loggers collected DO (mg/L), temperature (°C), and specific conductivity (µS/cm) measurements every 15 minutes and were deployed during the morning of August 11 and retrieved during the morning of August 26. The DO minimums and maximums exhibited diel patterns. The peak of DO levels occurred in the evening before sunset, and the minimum DO levels occurred in the early morning after sunrise.

Figure 6 illustrates the DO data for Station 0.1. DO ranged from 4.89 to 9.78 mg/L and temperature ranged from 20.57 to 28.35 °C. Specific conductance ranged from 364 to 468 µS/cm. During the deployment period, DO at station 0.1 fell below the 5.0 mg/L minimum established by the WQS (MoDNR 2014b) only once.

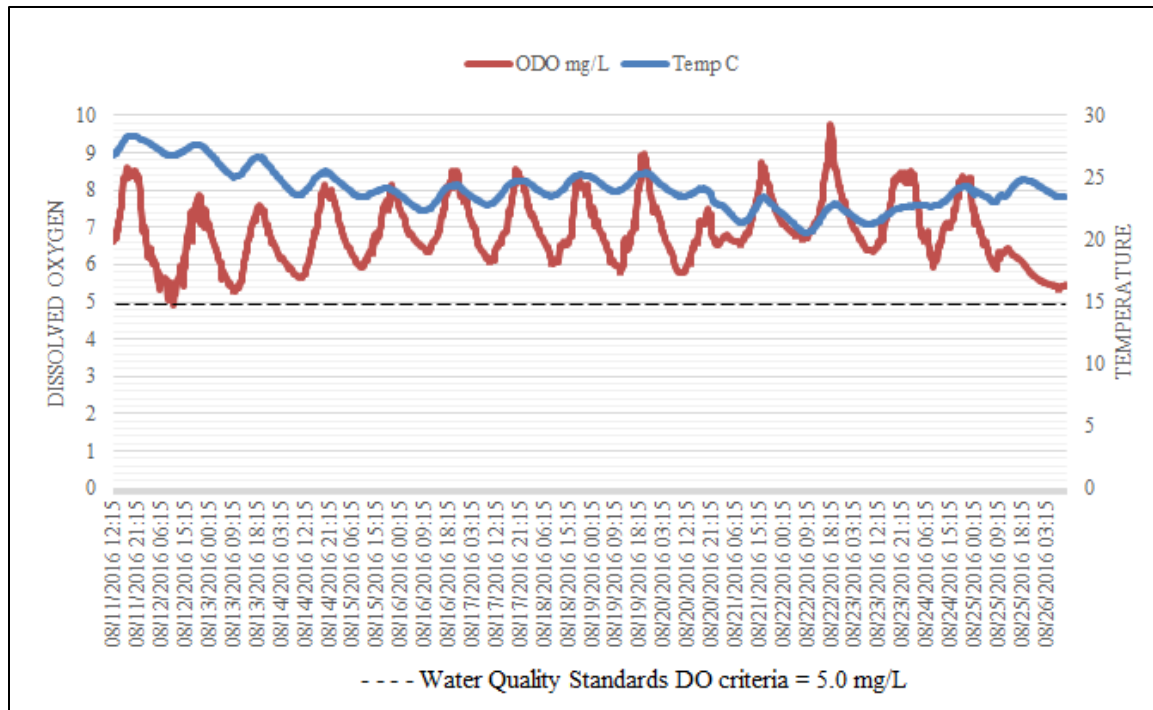


Figure 6. Multiparameter Sonde Results, Station 0.1

Figure 7 illustrates the DO data for Station 0.5. DO ranged from 3.08 to 7.52 mg/L and temperature ranged from 20.16 to 26.77 °C. Specific conductance ranged from 205 to 531 $\mu\text{S}/\text{cm}$. During the deployment period, DO at station 0.5 fell below the 5.0 mg/L minimum established by the WQS (MoDNR 2014b) 64 percent of the time.

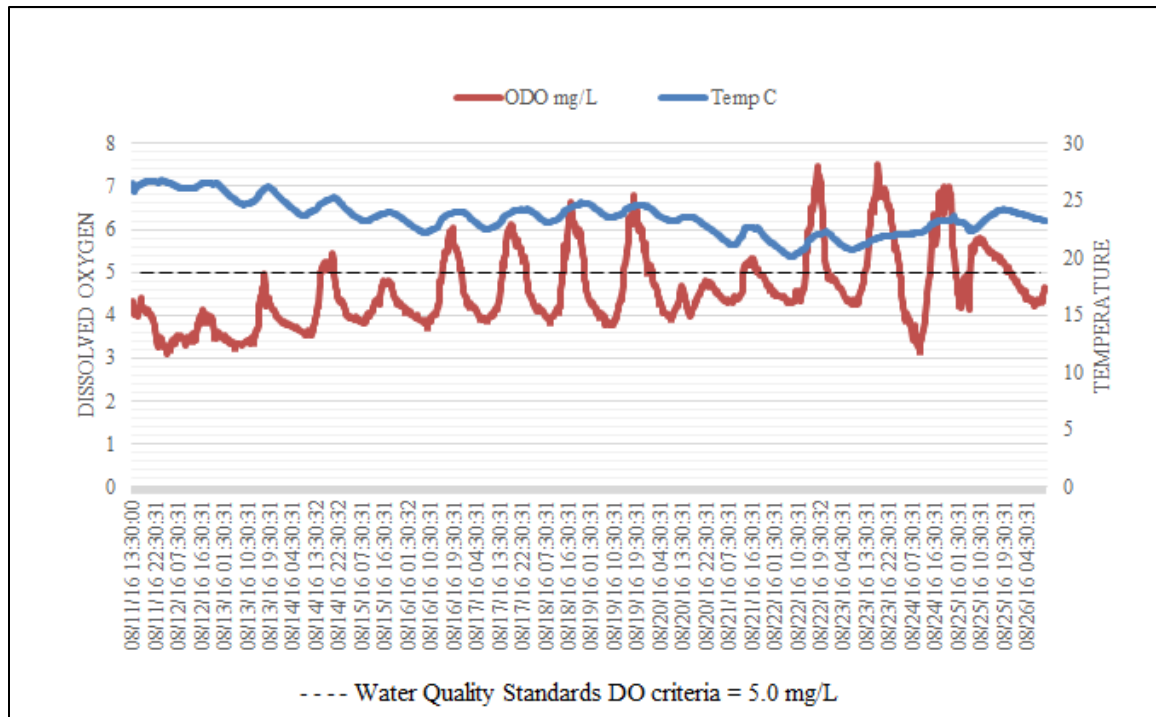


Figure 7. Multiparameter Sonde Results, Station 0.5

5.5 Physicochemical Water Parameters

Discharge and *in situ* results are presented in Tables 7 and 8. Physicochemical values varied throughout the watershed for each season.

DO levels ranged from 4.38 mg/L to 8.96 mg/L during the fall sampling period. pH was within the WQS criterion range of 6-9 at three stations but dropped just below the minimum criterion at station 1.0. Specific conductance increased as sampling moved upstream. Turbidity values were higher at the downstream station. Discharge was <1 cfs at all four stations.

Table 7
Fall 2016 Discharge and *In Situ* Water Quality Measurements

Stations	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Parameters				
Sampling time and date	1025h 9/15	1205h 9/15	1340h 9/15	1315h 9/15
Dissolved Oxygen (mg/L)	5.43	4.90	4.38	8.96
pH (su)	7.4	6.4	5.9	6.3
Specific Conductance (µS/cm)	225	289	363	449
Temperature (°C)	21.3	21.6	21.6	26.1
Turbidity (NTU)	24	17	17	9.3
Discharge (cfs)	0.6	0.5	0.3	0.2

Bold value noncompliance with Missouri's WQS

During the spring sampling season, DO levels ranged from 8.47 mg/L to 14.72 mg/L. pH values were higher during the spring, and all stations were within the WQS criterion range of 6-9. Specific conductance was also higher during the spring. Turbidity and discharge values were lower during the spring sampling period.

Table 8
Spring 2017 Discharge and *In Situ* Water Quality Measurements

Parameters	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Sampling time and date	0950h 3/22	1110h 3/22	1300h 3/22	1420 h 3/22
Dissolved Oxygen (mg/L)	8.47	10.20	11.29	14.72
pH (su)	8.2	8.3	8.9	9.0
Specific Conductance (µS/cm)	544	433	520	560
Temperature (°C)	10.8	11.6	10.5	13.6
Turbidity (NTU)	3.8	7.8	3.8	3.2
Discharge (cfs)	0.1	0.2	0.1	0.1

There are currently no nutrient criteria in place for Missouri streams and rivers. A TMDL was established by U. S. EPA on December 20, 2010, for total nitrogen, total phosphorus, and TSS (U. S. EPA 2010). Nutrient targets were based on U. S. EPA recommended concentrations (U. S. EPA 2000) for Level III ecoregion 40 (the Central Irregular Plains). Target concentrations are: 0.855 mg/L total nitrogen; 0.092 mg/L total phosphorus; and 17 mg/L TSS. Water chemistry concentrations are presented in Tables 9 and 10.

During the fall sampling season, total nitrogen exceeded the TMDL target value at the three stations located downstream of the Johnson County Egg Farm, LLC, and total phosphorus exceeded the target value at all four stations. Total phosphorus values were higher at the three stations downstream of the egg facility. TSS exceeded the target value at station 1.0 (the station immediately downstream of the egg facility, also with the illegal trash dumping). Ammonia as N, sulfate, and chloride were within acceptable concentration ranges based on the WQS (MoDNR 2014b).

Table 9
Fall 2016 Water Chemistry Concentrations

Stations	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Parameters				
Sampling time and date	1025h 9/15	1205h 9/15	1340h 9/15	1515h 9/15
Nitrate+Nitrite as N (mg/L)	0.53	0.91	1.33	0.25
Total Nitrogen (mg/L)	1.25	1.55	1.93	0.72
Total Phosphorus (mg/L)	0.31	0.24	0.28	0.14
Ammonia as N (mg/L)	0.15	0.17	0.22	0.14
Sulfate (mg/L)	26.8	35.4	44.6	75.9
Chloride (mg/L)	8.85	12.6	17.2	11.8
Total Suspended Solids (mg/L)	11.0	10.0	45.0	5.0

Values in bold exceed U.S. EPA recommendations (USEPA 2000).

During the spring sampling season, total phosphorus was the only parameter to exceed U. S. EPA TMDL criteria (U. S. EPA 2010). Elevated total phosphorus occurred at the three stations downstream of the egg facility. As was the case with fall samples, ammonia as N, sulfate, and chloride were within acceptable concentrations based on the WQS (MoDNR 2014b).

Table 10
Spring 2017 Water Chemistry Concentrations

Stations	Long Branch 0.1	Long Branch 0.5	Long Branch 1.0	Long Branch 1.9
Parameters				
Sampling time and date	0950h 3/22	1110h 3/22	1300h 3/22	1430h 3/22
Nitrate+Nitrite as N (mg/L)	<0.008 ND	<0.008 ND	<0.008 ND	<0.008 ND
Total Nitrogen (mg/L)	0.55	0.59	0.75	0.49
Total Phosphorus (mg/L)	0.13	0.15	0.31	0.05
Ammonia as N (mg/L)	0.5	0.6	0.08	0.05
Sulfate (mg/L)	68.5	45.2	47.0	80.6
Chloride (mg/L)	34.8	31.1	35.8	30.6
Total Suspended Solids (mg/L)	<5 ND	14	<5 ND	<5 ND

ND not detected at reported value; values in bold exceed U.S. EPA recommendations (USEPA 2000).

6.0 Discussion

6.1 Land Use

Long Branch originates in Johnson County, just southwest of Whiteman Air Force Base and flows east until its confluence with Muddy Creek in Pettis County. The headwaters of Long Branch traverse the base. The watershed for the study stream comprises mostly cropland and grassland. Combined, these two land uses cover approximately 85 percent of the watershed. Although the stream had mostly optimal riparian coverage at the individual study stations, the watershed as a whole has limited forestland (6.2 percent) when compared to the EDU (15.9 percent). Agricultural land use in a watershed is a

major contributor of sediment and nutrient runoff into aquatic systems (Harding et al. 1999, Burdon et al. 2013). A study from North Carolina comparing three streams with different land use types (forest, agriculture, urban) confirmed that land use of a watershed is a contributor to aquatic community structure (Lenat and Crawford 1994). This study found that watersheds dominated by agriculture versus forested landscapes had low EPT taxa numbers and higher taxa richness of tolerant taxa, indicating a moderate level of stress to the aquatic community (Lenat and Crawford 1994). The high percentage of cropland and grassland in the watershed along with runoff from the Johnson County Egg Farm likely contributed to high nutrient levels instream and the moderately tolerant to tolerant macroinvertebrate community.

6.2 Stream Habitat Assessment

The stream habitat assessment suggests that Long Branch's habitat should be capable of fully supporting a biological community. However, differences in habitat between the study stream and the BIOREF stream were apparent. The substrate at both streams was made up mostly of fine mud, silt, and clay; however, epifaunal habitat such as gravel, overhanging roots, and instream woody debris was limited at the study stream, likely limiting the diversity of the macroinvertebrate community. Instream habitat variables as well as catchment variables have been shown to influence aquatic communities (Wang et al. 2007, Burdon et al. 2013). The study stream lacked pool variability and channel sinuosity and had more sediment deposition. Vegetative protection of the banks was sparse or absent at each station. Burdon et al. (2013) studied streams in agricultural settings and found increased sedimentation causes a decrease in habitat availability, which led to decreased biodiversity. Although this study did not specifically examine sedimentation in Long Branch, the stream's substrate was mostly clay and silt. Clay and silt homogenize the substrate by filling interstitial spaces and voids that would otherwise be created with instream debris. A study on invertebrate conditions throughout the Corn Belt of the United States showed instream stressors were dominant factors driving macroinvertebrate communities (Waite and Van Metre 2017)

6.3 Biological Assessment and Macroinvertebrate Community Analysis

The farthest downstream station (0.1) was the only station to achieve fully supporting MSCI scores for both seasons (MSCI score of 20 in the fall and 16 in the spring). This was also the only test station to score optimally in the habitat category of epifaunal substrate and pool substrate characterization. Biological integrity has been shown to be associated with local instream habitat variables (Lammert and Allan 1999, Burdon et al. 2013).

Biological metric scores were not consistent among stations during either season. MSCI scores ranged from 14 to 20 among the four stations during the fall and from 10 to 16 during the spring. During the fall, EPTT was highest at the most downstream station with seven taxa present (one taxon higher than the optimal scoring threshold value). The remaining stations had two to four EPT taxa. During the spring, both EPTT and BI scored poorly at all four stations, with station 1.0 (the site with illegal dumping, downstream of

the egg facility) completely lacking EPT taxa. Burdon et al. (2013) determined sensitive taxa are more strongly associated with benthic habitat than with food resources. Lack of benthic habit therefore limits sensitive taxa.

The 2007-2008 bioassessment showed results similar to the present study, with EPTT and BI scoring poorly at each station during both seasons. The 2007-2008 bioassessment was conducted on two stations on Long Branch (station 1.0 and station 2.0, which was immediately upstream of the present station 1.9). Station 1.0 scored fully supporting during the fall and partial during the spring, whereas station 2.0 scored partially supporting during both seasons. The stream has not shown improvement since the prior study. The macroinvertebrate community may be suffering from long term effects of landscape alterations that have been taking place for several decades (Harding et al. 1998). It may only take a fragment of time to alter the surrounding landscape; however, it may take much longer for the macroinvertebrate community to recover from the long term sustained effects of anthropogenic disturbances (Harding et al. 1998).

Based on the comparison of percent sensitive taxa and the overall macroinvertebrate community composition, the macroinvertebrate community of Long Branch was made up primarily of moderately tolerant (BI range 5.0-7.4) to tolerant (BI range 7.5-8.9) taxa when compared to reference conditions. During the fall, dominant taxa were similar among stations. The Chironomidae *Tanytarsus* (BI = 6.7) and *Dicrotendipes* (BI = 7.9) and the heptageniid mayfly *Stenacron* (BI = 7.1) were some of the more commonly collected taxa at each station. Tubificidae (BI = 9.2) was present at all stations and was the second most commonly collected taxa at Station 1.0. *Physella* (BI = 9.1) was abundant at stations 0.1, 0.5, and 1.9 and the tenth most common taxon at station 1.0. Taxa with a BI value >8.9 are considered very tolerant to organic pollution.

During spring sampling, the Chironomidae taxa *Hydrobaenus* (BI = 9.6) and *Cricotopus/Orthocladius* (BI = 6.5) were common at all stations. *Hydrobaenus* composed 64 percent of the macroinvertebrate community at station 1.0. The remaining macroinvertebrate community varied among the stations. *Menetus* (BI = 8.4) was common at the two downstream stations. *C. latipennis* (BI = 7.6), second in abundance at the farthest upstream station, was absent at stations 0.5 and 1.0 and made up less than 1 percent of the farthest downstream sample. EPT taxa were entirely lacking at station 1.0. An undescribed dipteran taxa (no assigned BI value) was the second most commonly collected taxa at station 0.5, making up approximately 10 percent of the sample. In a North Carolina study, streams in agricultural settings showed an increase in taxa richness of tolerant groups and high abundance values for Chironomidae (Lenat and Crawford 1994).

During the fall of 2016, macroinvertebrate abundance varied among stations. According to the SMSBPP, laboratory subsampling will continue until the target number of specimens is reached (300 for each habitat in this study) or 50 percent of the sample is processed, whichever comes first (MoDNR 2012). Although not a quantitative measure,

relative abundance among stations can roughly be gauged by the amount of effort (as measured by percent subsampled) required to reach the target number. Three of the Long Branch samples required 50 percent of the woody debris sample to be subsampled. The non-flow and root mat samples ranged from 5.2 percent to 31 percent subsampled. In the spring, the woody debris at station 0.1 was subsampled at 50 percent, as it was in the fall. The remaining habitats at that station and all the habitats at the remaining stations ranged from 4.3 to 25 percent subsampled. Macroinvertebrate abundance was variable among stations and was low in the woody debris habitat, which itself was rare.

6.4 Multiparameter Data Sonde and Physicochemical Water Parameters

The multiparameter water quality sondes deployed at stations 0.1 and 0.5 recorded differences in DO between the two sites. Station 0.1, the farthest downstream, maintained the WQS 5.0 mg/L minimum DO criterion throughout the two weeks, with the exception of one reading on August 12. However, the sonde located at Station 0.5 recorded DO concentrations below the minimum criterion 64 percent of the time during the two-week deployment period. *In situ* DO concentrations also were below WQS during the fall sampling season at station 0.5, but DO was slightly above the criterion at station 0.1. Low DO levels can be detrimental to aquatic organisms (Allan 1995, Rounds et al. 2013). Low oxygen levels can occur near the bottom of the water column, thus affecting the benthic community. Taxa with high BI values are often associated with organic and nutrient pollution, which causes low DO values (Hilsenhoff 1987).

Stream channel morphology may have had an effect on station 0.5 DO concentrations. Station 0.5 was one long pool with incised banks, and a series of beaver dams was present immediately upstream of this reach. Although we did not encounter beaver dams in the station 0.5 sample reach, they were likely present throughout the watershed. The reach we sampled was relatively deep and had sluggish flow, suggestive of a beaver dam farther downstream. Sections of streams impounded by beaver dams have been shown to have low oxygen levels, and generally DO levels recover downstream of the dam outfalls (Rosell et al. 2005, Burchsted et al. 2016).

pH was low, nearing the lower WQS criterion in fall *in situ* sampling at stations 0.5 and 0.9, and pH was below the criterion at station 1.0. Beaver ponds have also been shown to cause low pH, presumably due to increased organic acids (Burchsted et al. 2016).

Long Branch failed to consistently meet the target values for total nitrogen, total phosphorus and TSS established by U. S. EPA's TMDL during the fall (U. S. EPA 2010). In the spring, total phosphorus was the only parameter that failed to meet the target value. During the deployment of the data sondes over the summer months and during the fall sampling season, staff did not observe excessive algae. Although algae was not quantitatively assessed, algae was noted at three of the stations during the spring sampling season, particularly near the riffle habitats. Excessive nutrients can potentially threaten aquatic communities by causing algal blooms and eutrophication. High levels of nutrients result in degraded aquatic communities (Dodds et al. 2009, Waite and Van

Metre 2017, Wang et al. 2007). Low biodiversity and significant amounts of filamentous algae were some of the observations that initially led Long Branch to be listed on the 2002 303(d) list.

The 2007-2008 bioassessment reported low DO at the two stations sampled, with station 2.0 having a DO value of 1.74 mg/L. Nutrient parameters were not elevated during the fall 2007 sampling event, but total nitrogen was elevated during the spring (2.26 mg/L at station 1.0 and 1.35 mg/L at station 2.0).

7.0 Summary

The majority of Long Branch MSCI scores in this study were below fully supporting status. Low MSCI scores were likely due to nutrient enrichment and low DO. Tests of the null hypotheses resulted in the following conclusions:

- 1) Land cover characteristics in the Long Branch watershed will be similar to the land cover characteristics of the Central Plains/Blackwater/Lamine EDU. This hypothesis is accepted. Although differences existed, the land use comparison between the 12-digit HUC and the Central Plains/Blackwater/Lamine showed that overall, similar land use characteristics occurred between the two.
- 2) Stream habitat assessment scores of Long Branch will be similar to those of East Fork Crooked River (the BIOREF control stream). This hypothesis is accepted. The SHAPP scores of the study stations all scored >75% of the SHAPP control stream.
- 3) The Long Branch macroinvertebrate community will be similar among longitudinally separate sample reaches. This hypothesis is rejected. Differences existed in the biological metric results and the MSCI scores longitudinally throughout the study stream for each sampling season.
- 4) The macroinvertebrate community in Long Branch will be similar to the macroinvertebrate community of BIOREF streams in the Central Plains/Blackwater/Lamine EDU. This hypothesis is rejected. Only one station, the farthest downstream station, attained fully supporting MSCI scores during both seasons.
- 5) Physicochemical water quality of Long Branch will meet the WQS and target levels established by the U. S. EPA's TMDL (U. S. EPA 2010). This hypothesis is rejected. Dissolved oxygen fell below the 5.0 mg/L criterion during the two-week data sonde deployment period and also during the fall sampling. Total nitrogen and total phosphorus were both elevated compared to the target levels established by the U. S. EPA's TMDL during the fall sampling period. Total phosphorus was elevated during the spring sampling.

Additionally, station 1.0 is noncompliant with state narrative criteria, which prohibit used tires, car bodies, appliances, demolition debris, used vehicles and equipment, and any

solid waste in water bodies of the State of Missouri (MoDNR 2014b). Station 1.0 appeared to have historically been, and continues to be a dump site of solid waste. Dump sites not only create a public nuisance but can also cause health issues by attracting rodents and pests and cause environmental contamination to streams, rivers, groundwater, and wells.

8.0 Literature Cited

- Allan, J. D. 1995. Stream Ecology. Chapman and Hall, London. 388 pp.
- Burchsted, D., C. Brehme, M. B. Green, J. M. Jacobs, W. Wollheim. 2016. Natural dams and biogeochemistry at the river network scale: implications for water quality. NH WRRC Annual Report, REO Activities. Burshsted Project 2014NH183B
- Burdon, F. J., A. R. McIntosh, and J. S. Harding. 2013. Habitat loss drives threshold response of benthic invertebrate communities to deposited sediment in agricultural streams. *Ecological Applications* 23(5): 1036-1047.
- Dodds, W. K. W. W. Bouska, J. L. Eitsmann, T. J. Pilger, K. L. Pitts, A. J. Riley, D. J. Thornbrugh. 2009. Eutrophication of U. S. Freshwaters: Analysis of Potential Economic Damages. *Environmental Science and Technology* 43(1): 12-19.
- Harding, J. S. , E. F. Benfield, P. V. Bolstad, G. S. Helfman, and E. B. D. Jones III. 1998. Stream Biodiversity: The ghost of land use past. *Proceeding of the National Academy of Sciences, USA*. 95: 14843-14847.
- Harding , J. S. , R. G. Young, J. W. Hayes, K. A. Shearer and J. D. Stark. 1999. Changes in agricultural intensity and river health along a river continuum. *Freshwater Biology*. 42: 345-357.
- Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. *The Great Lakes Entomologist* 20(1): 31-39.
- Lammert, M. and J. D. Allan. 1999. Assessing biotic integrity of streams: effects of scale in measuring the influence of land use/cover and habitat structure on fish and macroinvertebrates. *Environmental Management* 23: 257-270.
- Lenat, D. R., and J. K. Crawford. 1994. Effects of Land Use on Water Quality and Aquatic Biota of Three North Carolina Piedmont Streams. *Hydrobiologia* 294:185-199.
- Missouri Department of Conservation. 2015. Missouri Pollution and Fish Kill Investigations 2015. Missouri Department of Conservation Aquatic Health Unit, Resource Science Division, 3500 East Gans Road, Columbia, Missouri. 34 pp.
- Missouri Department of Natural Resources. 2008. Biological Assessment and Habitat Study Report. Long Branch, Pettis and Johnson Counties, 2007 and 2008. Environmental Services Program, P. O. Box 176, Jefferson City, Missouri. 36 pp.
- Missouri Department of Natural Resources. 2012. Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure. Missouri Department of Natural

Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 29 pp.

Missouri Department of Natural Resources. 2013. Standard Operating Procedure MDNR-ESP-210: Quality Assurance/Quality Control for Environmental Data Collection. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 13 pp.

Missouri Department of Natural Resources. 2014a. Standard Operating Procedure MDNR-ESP- 104: Continuous Monitoring of Water Quality Using a Dissolved Oxygen, Specific Conductivity, pH, Turbidity, Rhodamine Dye, and Temperature Data Logger. Missouri Department of Natural Resources, Water Pollution Control Program, P.O. Box 176, Jefferson City, Missouri 65102. 9 pp.

Missouri Department of Natural Resources. 2014b. Title 10. Rules of Department of Natural Resources Division 20-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031 Water Quality Standards. Missouri Department of Natural Resources, Water Pollution Control Program, P.O. Box 176, Jefferson City, Missouri 65102. pp. 1-135.

Missouri Department of Natural Resources. 2015. Standard Operating Procedure MDNR-ESP-113: Flow Measurements in Open Channels. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 16 pp.

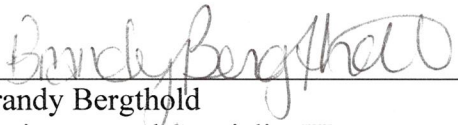
Missouri Department of Natural Resources. 2016a. Standard Operating Procedure MDNR-ESP-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 27 pp.

Missouri Department of Natural Resources. 2016b. Standard Operating Procedure MDNR-ESP-012: Analysis of Turbidity Using the Hack 2100p Portable Turbidimeter. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 11 pp.

Missouri Department of Natural Resources. 2016c. Standard Operating Procedure MDNR-ESP-100: Field Analysis of Water Samples for pH. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 7 pp.

Missouri Department of Natural Resources. 2016d. Standard Operating Procedure

Submitted by:

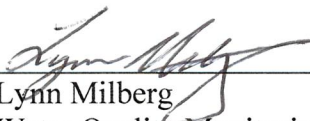


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MDNR-ESP-101: Field Measurement of Water Temperature. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 3 pp.

Missouri Department of Natural Resources. 2016e. Standard Operating Procedure MDNR-ESP-102: Field Analysis for Specific Conductance. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 9 pp.

Missouri Department of Natural Resources. 2016f. Standard Operating Procedure MDNR-ESP-103: Field Analysis of Dissolved Oxygen Using Meters. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 11 pp.

Missouri Department of Natural Resources. 2016g. Standard Operating Procedure MDNR-ESP-209: Taxonomic Levels for Macroinvertebrate Identifications. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 40 pp.

Missouri Department of Natural Resources. 2016h. Standard Operating Procedure MDNR-ESP-213: Quality Control Procedures for Checking Water Quality Field Instruments. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 13 pp.

Missouri Department of Natural Resources. 2016i. Standard Operating Procedure MDNR-ESP-214: Quality Control Procedures for Data Processing. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 7 pp.

Missouri Department of Natural Resources. 2016j. Stream Habitat Assessment Project Procedure. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 65102. 40 pp.

Rosell, F., O. Bozer, P. Collen, H. Parker. 2005. Ecological impact of beavers *Castor fibre* and *Castor canadensis* and their ability to modify ecosystems. Mammal Review 35: 248-276.

Rounds, S. A. , Wilde, F. D. , and Ritz, G. F. 2013. Dissolved oxygen (ver. 3. 0): U. S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chap. A6, Sec. 6. 2.

Sowa, S. P. , D. D. Diamond, R. A. Abbitt, G. M. Annis, T. Gordon, M. E. Morey, G. R. Sorensen, and D. True. 2004. Final Report of the Aquatic Component of GAP

- Analysis: A Missouri Prototype. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 111 pp.
- United States Environmental Protection Agency. 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Streams in Nutrient Ecoregion IX. EPA-822-B-00-019. 108 pp.
- United States Environmental Protection Agency. 2010 Total Maximum Daily Load For Total Nitrogen, Total Phosphorus and Total Suspended Solids, Long Branch (MO_857) Johnson and Pettis Counties, Missouri. 94 pp.
- Waite I. R. and P. C. Van Metre. 2017. Multistressor predictive models of invertebrate condition in the Corn Belt, USA. *Freshwater Science*. 36(4): 901-914.
- Wang, L. D. M. Robertson, and P. J. Garrison. 2007. Linkages between nutrients and assemblages of macroinvertebrates and fish in Wadeable streams: Implication to nutrient criteria development. *Environmental Management* 39: 194-212.

Appendix A

Invertebrate Database Bench Sheet Report Fall 2016 and Spring 2017;
Long Branch, Johnson and Pettis Counties
Grouped by Season and Station

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16100], Station #0. 1, Sample Date: 9/15/2016 10:20:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	5	13	2
AMPHIPODA			
Hyalella azteca		5	
ARHYNCHOBDELLIDA			
Erpobdellidae	4		
BASOMMATOPHORA			
Ancylidae	11	28	14
Menetus	1	23	1
Physella	10	41	5
COLEOPTERA			
Berosus	1	7	3
Dubiraphia		12	1
Scirtidae		2	3
Stenelmis	29	1	1
DECAPODA			
Faxonius virilis		1	
DIPTERA			
Ablabesmyia	28	10	8
Anopheles		2	
Ceratopogonidae			1
Chironomidae	8	8	10
Chironomus	5		8
Chrysops	1		
Cladotanytarsus	3		3
Corynoneura	1	2	
Cryptochironomus	7		3
Cryptotendipes	2		7
Dicrotendipes	15	9	56
Diptera	1		
Glyptotendipes		2	6
Kiefferulus			1
Labrundinia	1	10	2
Nanocladius		2	
Paratanytarsus	2	6	
Paratendipes	8		5
Phaenopsectra		4	

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16100], Station #0. 1, Sample Date: 9/15/2016 10:20:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum fallax grp			2
Polypedilum flavum		2	2
Polypedilum halterale grp			1
Polypedilum illinoense grp	1	7	7
Polypedilum scalaenum grp	2		2
Procladius	11	1	23
Stenochironomus		1	1
Tanytarsus	49	24	68
Thienemannimyia grp.			5
Tribelos			1
EPHEMEROPTERA			
Acerpenna		1	
Baetis		1	4
Caenis latipennis		3	2
Centroptilum			7
Procloeon	1		1
Stenacron	4	16	13
Stenonema femoratum	44	2	6
HEMIPTERA			
Belostoma		-99	
Corixidae			2
Microvelia		1	
Rheumatobates	1	2	
ISOPODA			
Lirceus		1	
NEOTAENIOGLOSSA			
Hydrobiidae	8	1	6
ODONATA			
Argia	1	14	2
Calopteryx		1	
Enallagma		30	
Erythemis		-99	
Libellula		-99	
Nasiaeschna pentacantha		1	1
TUBIFICIDA			
Tubificidae	22		
VENEROIDA			
Pisidiidae	-99		1

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16101], Station #0. 5, Sample Date: 9/15/2016 12:10:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	2	10	3
ARHYNCHOBDELLIDA			
Erpobdellidae	3	2	
BASOMMATOPHORA			
Ancylidae	15	5	3
Menetus	19	120	11
Physella	9	60	10
COLEOPTERA			
Berosus	2	2	
Dubiraphia	1	10	2
DECAPODA			
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	16	4	6
Chironomus	2		
Chrysops	1		
Cladotanytarsus	14	1	2
Corynoneura	1	1	
Cryptochironomus	7		1
Cryptotendipes	10		1
Dicrotendipes	11	1	128
Diptera	1		
Forcipomyiinae	1		
Glyptotendipes	6		18
Goeldichironomus			1
Hydrobaenus	1		
Kiefferulus	2		8
Labrundinia	1	3	1
Nanocladius	2		2
Paralauterborniella	1		
Paratanytarsus	12	15	2
Paratendipes			1
Phaenopsectra	4	3	9
Polypedilum fallax grp	1		19
Polypedilum flavum			14
Polypedilum halterale grp	8		
Polypedilum illinoense grp	2	14	4

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16100], Station #0. 1, Sample Date: 9/15/2016 10:20:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum scalaenum grp			1
Procladius	5		
Tanytarsus	213	43	94
Thienemanniella			1
Thienemannimyia grp.		3	
Tribelos			1
EPHEMEROPTERA			
Baetis			5
Stenacron			14
HEMIPTERA			
Microvelia		1	
Neoplea		1	
Rheumatobates		1	1
MEGALOPTERA			
Chauliodes rastricornis		-99	
NEOTAENIOGLOSSA			
Hydrobiidae		2	
ODONATA			
Argia	1	9	
Calopteryx		2	
Enallagma		2	
Erythemis		-99	
Ischnura		1	
Libellula		1	
RHYNCHOBDELLIDA			
Glossiphoniidae		2	
TRICHOPTERA			
Cheumatopsyche			5
TUBIFICIDA			
Tubificidae	19		2
VENEROIDA			
Pisidiidae	5		

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16102], Station #1, Sample Date: 9/15/2016 1:45:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4		1
AMPHIPODA			
Hyaella azteca		1	
ARHYNCHOBDELLIDA			
Erpobdellidae	2		
BASOMMATOPHORA			
Ancylidae	2	9	25
Menetus		3	4
Physella	5	13	3
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia		1	
Scirtidae		10	
Stenelmis	1		
DECAPODA			
Faxonius virilis			1
DIPTERA			
Ablabesmyia	31	9	17
Anopheles		1	
Apedilum	1		
Ceratopogoninae	1		
Chironomidae	9	4	4
Cladotanytarsus	2		
Corynoneura	1		
Cryptochironomus	15		2
Cryptotendipes	7		
Culicidae		2	
Dicrotendipes	12	12	81
Diptera	1		
Forcipomyiinae			2
Glyptotendipes	3	2	10
Kiefferulus	3		1
Labrundinia		11	7
Nanocladius	3	8	
Parachironomus	1		
Paralauterborniella	2		

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16102], Station #1, Sample Date: 9/15/2016 1:45:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Paratanytarsus	8	34	11
Paratendipes	18		1
Phaenopsectra	11	13	2
Polypedilum fallax grp		2	
Polypedilum flavum			1
Polypedilum halterale grp	8		
Polypedilum illinoense grp	3	62	5
Polypedilum scalaenum grp	3		
Rheotanytarsus			3
Stenochironomus		1	8
Tanytarsus	125	148	95
Thienemanniella			1
Thienemannimyia grp.			1
EPHEMEROPTERA			
Caenis latipennis	1	1	2
Stenacron	5	22	7
HEMIPTERA			
Belostoma		-99	
Microvelia		1	
Rheumatobates	1		
ODONATA			
Argia		14	1
Calopteryx		4	
Ischnura		1	
Libellula		1	
Nasiaeschna pentacantha		1	
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICHOPTERA			
Cheumatopsyche			3
Hydroptila			1
TUBIFICIDA			
Limnodrilus hoffmeisteri	1		
Tubificidae	57		4
VENEROIDA			
Pisidiidae	4		5

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16103], Station #1. 9, Sample Date: 9/15/2016 3:20:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	5	2
AMPHIPODA			
Hyaella azteca		42	3
ARHYNCHOBDELLIDA			
Erpobdellidae	9	-99	
BASOMMATOPHORA			
Ancylidae	3		
Menetus		5	1
Physella	20	82	20
COLEOPTERA			
Berosus	32	12	6
Dubiraphia	10	74	2
Enochrus		1	
Hydrophilidae		1	
Neoporus		1	
Paracymus		1	
Scirtidae			2
Stenelmis	2	2	
Tropisternus		1	
DIPTERA			
Ablabesmyia	34	1	1
Ceratopogoninae	2		
Chironomidae	8		
Chironomus			1
Chrysops	1		
Cladotanytarsus	3		
Cricotopus bicinctus		1	
Cryptochironomus	8		1
Cryptotendipes	2		
Dicrotendipes	8	2	43
Dolichopodidae			1
Glyptotendipes			1
Goeldichironomus	1		
Kiefferulus			1
Labrundinia		1	
Larsia		2	1
Nilothauma			1

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [16103], Station #1. 9, Sample Date: 9/15/2016 3:20:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Paralauterborniella	1		
Paratanytarsus	1	6	3
Paratendipes	13		
Polypedilum halterale grp	4		
Polypedilum illinoense grp	1	1	3
Polypedilum scalaenum grp	3		
Procladius	3		
Pseudochironomus	1		1
Stenochironomus			5
Tanytus	1		
Tanytarsus	49	4	6
EPHEMEROPTERA			
Caenis latipennis	58	30	13
Stenacron	2		1
HEMIPTERA			
Belostoma		1	
ODONATA			
Argia		1	
Enallagma	2	12	
Erythemis		-99	
Libellulidae	2	2	
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICLADIDA			
Planariidae		5	
TUBIFICIDA			
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	2		
Tubificidae	28		
VENEROIDA			
Corbicula	6	-99	1
Pisidiidae	6		1

Aquad Invertebrate Database Bench Sheet Report

Long Branch Cr [17071], Station #0. 1, Sample Date: 3/22/2017 9:50:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	5	
ARHYNCHOBDELLIDA			
Erpobdellidae	2	1	
BASOMMATOPHORA			
Ancylidae	4	8	2
Helisoma	-99		
Menetus		58	
Physella	-99	3	
COLEOPTERA			
Berosus		3	
Dubiraphia		10	
Helichus basalis		1	
Scirtidae		21	
Stenelmis	6	3	1
DIPTERA			
Ablabesmyia	4	5	
Ceratopogoninae	1		
Chironomidae		1	
Chironomus	8		
Cladotanytarsus	2		
Cricotopus sylvestris grp		1	
Cricotopus/Orthocladius	9	25	9
Cryptochironomus	2		
Cryptotendipes	4		
Dicrotendipes	3	9	4
Diptera	9		2
Glyptotendipes		8	7
Hydrobaenus	293	12	11
Kiefferulus	1	1	2
Labrundinia		22	1
Micropsectra	3	10	1
Nanocladius		4	
Nilothauma	2	3	1
Parakiefferiella		1	
Paratanytarsus		3	
Paratendipes	18	12	3
Phaenopsectra		4	3

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17071], Station #0. 1, Sample Date: 3/22/2017 9:50:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum fallax grp		2	8
Polypedilum halterale grp		3	
Polypedilum illinoense grp		16	
Polypedilum scalaenum grp		2	
Procladius	2	2	1
Sciomyzidae		1	
Tanytarsus	18	24	1
Thienemannimyia grp.		5	8
EPHEMEROPTERA			
Acentrella	1		
Caenis latipennis	1	3	1
Stenacron		3	1
HEMIPTERA			
Belostoma		1	
Ranatra fusca		1	
NEOTAENIOGLOSSA			
Hydrobiidae	4		
ODONATA			
Argia		3	
Enallagma		11	
Nasiaeschna pentacantha		-99	
Somatochlora		-99	
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICHOPTERA			
Ironoquia		-99	1
Oecetis			1
TRICLADIDA			
Planariidae		5	
TUBIFICIDA			
Tubificidae	5		
VENEROIDA			
Corbicula	1		
Pisidiidae		1	

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17072], Station #0. 5, Sample Date: 3/22/2017 11:10:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		13	1
ARHYNCHOBDELLIDA			
Erpobdellidae	2		
BASOMMATOPHORA			
Ancylidae	1	1	3
Lymnaeidae		1	
Menetus	11	22	26
Physella		10	6
COLEOPTERA			
Gyrinus			-99
Peltodytes		1	
Scirtidae		3	7
Stenelmis	3		
DIPTERA			
Ablabesmyia			1
Ceratopogoninae		2	
Chironomidae	3	4	5
Chironomus		1	
Corynoneura		1	
Cricotopus/Orthocladius	2	92	49
Dicrotendipes	2	16	19
Diplocladius	1	5	2
Diptera	88	1	1
Glyptotendipes	1	9	29
Hydrobaenus	79	76	59
Kiefferulus	1	3	1
Limonia			1
Micropsectra	8	17	6
Nilothauma			1
Parakiefferiella		1	
Paratendipes	45	1	4
Phaenopsectra		3	9
Polypedilum fallax grp		1	20
Polypedilum flavum	2		
Polypedilum halterale grp	5		
Polypedilum illinoense grp		2	7
Polypedilum scalaenum grp	1		

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17072], Station #0. 5, Sample Date: 3/22/2017 11:10:00 AM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Sciomyzidae		1	2
Tanytarsus	3	5	14
Thienemannimyia grp.		9	15
EPHEMEROPTERA			
Stenacron			7
HEMIPTERA			
Microvelia		1	
NEOTAENIOGLOSSA			
Hydrobiidae	1	1	
ODONATA			
Ischnura		1	
Nasiaeschna pentacantha			-99
TRICHOPTERA			
Cheumatopsyche	1		
TRICLADIDA			
Planariidae		9	1
TUBIFICIDA			
Ilyodrilus templetoni	5		
Limnodrilus claparedianus	5		
Limnodrilus hoffmeisteri	7		
Tubificidae	36		
VENEROIDA			
Corbicula	5		
Pisidiidae	10		

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17073], Station #1, Sample Date: 3/22/2017 1:00:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina			4
AMPHIPODA			
Crangonyx		2	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
BASOMMATOPHORA			
Ancylidae		6	
Menetus		2	
Physella	-99	-99	8
COLEOPTERA			
Scirtidae		2	
DIPTERA			
Ablabesmyia	2		
Ceratopogoninae	1		
Chironomidae			3
Chironomus	3		
Cricotopus/Orthocladius	5	36	55
Cryptotendipes	12		
Dicrotendipes	1	5	2
Diplocladius		1	
Glyptotendipes		7	2
Hydrobaenus	204	201	208
Kiefferulus			1
Micropsectra	7	30	23
Parakiefferiella		1	
Paratanytarsus			1
Paratendipes	37		1
Phaenopsectra		7	1
Polypedilum flavum			3
Polypedilum halterale grp	3	2	
Polypedilum illinoense grp		10	
Polypedilum scalaenum grp	1		
Sciomyzidae		1	
Stenochironomus			1
Tanytarsus	6	9	9
Thienemanniella		1	
HEMIPTERA			

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17073], Station #1, Sample Date: 3/22/2017 1:00:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Belostoma		-99	
ODONATA			
Argia		1	
Calopteryx		1	
Nasiaeschna pentacantha		2	
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICLADIDA			
Planariidae		2	
TUBIFICIDA			
Enchytraeidae		1	
Ilyodrilus templetoni	8		
Limnodrilus claparedianus	2		
Limnodrilus hoffmeisteri	1	1	
Tubificidae	7	1	1
VENEROIDA			
Pisidiidae		-99	1

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17074], Station #1. 9, Sample Date: 3/22/2017 2:25:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	6	9	6
AMPHIPODA			
Crangonyx		3	
Hyaella azteca	1	47	
ARHYNCHOBDSELLIDA			
Erpobdellidae	1	-99	
BASOMMATOPHORA			
Menetus	1	10	2
Physella		6	3
COLEOPTERA			
Berosus	6	16	6
Dubiraphia	9	39	6
Dytiscidae		1	
Peltodytes	1	1	
DECAPODA			
Faxonius virilis	-99		
DIPTERA			
Ablabesmyia	6	9	6
Ceratopogoninae	13	2	2
Cladotanytarsus	4		2
Cricotopus bicinctus	6	4	3
Cricotopus/Orthocladus	20	26	63
Cryptochironomus	4		4
Cryptotendipes	29		
Dicrotendipes	14	5	54
Diplocladius		1	1
Diptera	3	1	2
Hydrobaenus	46	5	9
Labrundinia			4
Micropsectra	10	7	2
Nanocladius		1	
Nilothauma			2
Paralauterborniella	2		
Paratanytarsus	1	2	1
Paratendipes	18	2	1
Phaenopsectra		1	2
Polypedilum fallax grp	2		1

Aquid Invertebrate Database Bench Sheet Report

Long Branch Cr [17074], Station #1. 9, Sample Date: 3/22/2017 2:25:00 PM

NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum flavum		1	1
Polypedilum halterale grp	8	1	1
Polypedilum illinoense grp		11	14
Polypedilum scalaenum grp	11		
Rheotanytarsus			2
Stenochironomus	1	1	4
Tanypus	2		
Tanytarsus	51	21	36
Zavrelimyia	1	7	3
EPHEMEROPTERA			
Caenis latipennis	31	108	38
Stenacron		3	
HEMIPTERA			
Microvelia		3	5
ODONATA			
Calopteryx			-99
Ischnura	1	37	
Libellula		1	1
Nasiaeschna pentacantha		1	
RHYNCHOBDELLIDA			
Glossiphoniidae	1	1	
TRICHOPTERA			
Limnephilidae		1	
TRICLADIDA			
Planariidae		3	
TUBIFICIDA			
Enchytraeidae		1	
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	6		1
Tubificidae	5		
VENEROIDA			
Corbicula	3	1	4